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ENVIRONMENTAL SATELLITES

Planning Required to Mitigate Near-term Risks and Ensure Long-term Continuity

Statement of David A. Powner,
Director Information Technology
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ENVIRONMENTAL SATELLITES

Planning Required to Mitigate Near-term Risks and Ensure Long-term Continuity

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Highlights

Highlights of GAO-10-858T, a testimony before the Subcommittee on Investigations and Oversight, Committee on Science and Technology, House of Representatives

Why GAO Did This Study

Environmental satellites provide data used for weather forecasting, measuring variations in climate over time, and predicting space weather. Due to the continuing cost, schedule, and tri-agency management challenges of the National Polar-orbiting Operational Environmental Satellite System (NPOESS)—a key satellite acquisition managed by the National Oceanic and Atmospheric Association (NOAA), the Department of Defense (DOD), and the National Aeronautics and Space Administration (NASA)—the White House's Office of Science and Technology Policy (OSTP) decided in February 2010 to disband NPOESS and, instead, to have NOAA and DOD undertake separate acquisitions.

GAO was asked to summarize its report being released today on plans for NOAA's and DOD's separate acquisitions and the key risks of the transition, as well as its recent work on federal efforts to establish long-term strategies for satellite-provided climate and space weather data.

What GAO Recommends

In its reports, GAO recommended that NOAA and DOD address key transition risks, and that the President's Assistant for Science and Technology implement interagency strategies for the long-term provision of environmental observations. NOAA and DOD agreed, while the Assistant's office neither agreed nor disagreed, but noted its plan to develop a strategy for earth observations.

View GAO-10-858T or key components. For more information, contact David A. Powner at (202) 512-9286 or pownerd@gao.gov.

What GAO Found

OSTP's decision to disband NPOESS came at a time when the program's cost estimate had more than doubled—to over $15 billion, the launch date for a demonstration satellite had been delayed by over 5 years, and the tri-agency management structure had repeatedly proven to be ineffective. To implement the decision, NOAA and DOD have begun planning for separate acquisitions to replace NPOESS. NOAA has developed preliminary plans for its new program—called the Joint Polar Satellite System—to meet the requirements of the afternoon NPOESS orbit. DOD expects to make final decisions on the spacecraft and sensors in August 2010. However, because neither agency has completed its plans, the impact of the decision to disband the program on the expected costs, schedules, and capabilities has not yet been determined. Moving forward, the agencies face key risks in transitioning from NPOESS to their separate programs, including the loss of key staff and capabilities, delays in negotiating contract changes and establishing new program offices, the loss of support for the other agency's requirements, insufficient oversight of new program management, and cost growth resulting from contract and program changes. While NOAA and DOD are establishing plans for their new programs, the development of key NPOESS components is continuing. However, the launch date of the demonstration satellite—to be used operationally to ensure climate and weather data continuity—has been delayed by 9 months, and the program has slowed down work on all development activities. Until the transition risks are effectively mitigated, and unless components are able to continue scheduled development, it is likely that launch dates will continue to be delayed. Further delays are likely to jeopardize the availability and continuity of critical weather and climate data.

For over a decade, the climate community has clamored for a national interagency strategy that coordinates agency priorities, budgets, and schedules for environmental satellites over the long-term—and the governance structure to implement that strategy. While the federal government has taken several steps to ensure the provision of environmental data from satellites for both climate and space weather in the short term, federal efforts to ensure the long-term provision of these environmental measurements are still lacking. Specifically, although both the climate and space weather communities have recently drafted reports for OSTP containing recommendations for climate and space weather satellites, respectively, the climate report focuses only on short-term needs and does not include longer term priorities, nor does it include budgets or schedules. Further, OSTP does not have plans for finalizing or releasing either the climate or space weather reports. Until an interagency strategy for environmental observation is established, and a clear process for implementing it is in place, federal agencies will continue to procure their immediate priorities on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and our nation's ability to understand long-term climate changes may be limited.

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to participate in today's hearing on efforts to disband the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and federal planning to ensure long-term environmental monitoring from satellites. NPOESS was planned to be a state-of-the-art, environment-monitoring satellite system that would replace two existing polar-orbiting environmental satellite systems. Managed jointly by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD)/U.S. Air Force, and the National Aeronautics and Space Administration (NASA), the program was considered critical to the nation's needs through the year 2026. However, to address continuing cost, schedule, management, and technical challenges, the White House's Office of Science and Technology Policy (OSTP) decided in February 2010 to disband the NPOESS acquisition and, instead, to have NOAA and DOD undertake separate acquisitions. As requested, this statement summarizes our report being released today on plans for NOAA's and DOD's separate acquisitions and the key risks of transitioning from NPOESS to these new programs, as well as our recent work on federal efforts to establish long-term strategies for satellite-provided climate and space weather data.[1]

In preparing this testimony, we relied on the work supporting the corresponding reports. Those reports contain detailed overviews of our scope and methodology. All of our work for the reports was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[1]GAO, *Polar-orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks That Jeopardize the Continuity of Weather and Climate Data*, GAO-10-558 (Washington, D.C.: May 27, 2010), and *Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements*, GAO-10-456 (Washington, D.C.: Apr. 27, 2010).

Background

Since the 1960s, the United States has used satellites to observe the earth and its land, oceans, atmosphere, and space environments. Satellites provide a global perspective of the environment and allow observations in areas that may be otherwise unreachable or unsuitable for measurements. Used in combination with ground, sea, and airborne observing systems, satellites have become an indispensable part of measuring and forecasting weather and climate. For example, satellites provide the graphical images used to identify current weather patterns, as well as the data that go into numerical weather prediction models. These models are used to forecast weather 1 to 2 weeks in advance and to issue warnings about severe weather, including the path and intensity of hurricanes. Satellite data are also used to warn infrastructure owners when increased solar activity is expected to affect key assets, including communication satellites or the electric power grid. When collected over time, satellite data can also be used to observe climate change—the trends and changes in the earth's climate. For example, these data are used to monitor and project seasonal, annual, and decadal changes in the earth's temperature, vegetation coverage, and ozone coverage.

Satellite-provided Environmental Data for Climate and Space Weather

One key subset of satellite-provided data is climate data. These data are used in combination with ground and ocean observing systems to understand seasonal, annual, and decadal variations in the climate. Satellites provide land observations such as measurements of soil moisture, changes in how land is used, and vegetation growth; ocean observations such as sea levels, sea surface temperature, and ocean color; and atmospheric observations such as greenhouse gas levels (e.g., carbon dioxide), aerosol and dust particles, and moisture concentration. When these data are obtained over long periods of time, scientists are able to use them to determine short- and long-term trends in how the earth's systems work and how they work together. For example, climate measurements have allowed scientists to better understand the effect of deforestation on how the earth absorbs heat, retains rainwater, and absorbs greenhouse gases. Scientists also use climate data to help predict climate cycles that affect the weather, such as El Niño, and to develop global estimates of food crop production for a particular year or season.

Another subset of satellite-provided environmental information is space weather data. Satellite-provided observations of space weather generally describe changes in solar activity in the space environment. Just as scientists use observations of weather that occurs on the earth's surface and in its atmosphere to develop forecasts, scientists and researchers use

space weather observations to detect and forecast solar storms that may be potentially harmful to society.

Coordination and Oversight of Satellite-Provided Environmental Observations

NASA, NOAA, and DOD all have responsibilities for acquiring, processing, and disseminating environmental data and information from research or operational satellites. In addition to these agencies, there are two interagency organizations—the U.S. Group on Earth Observations (USGEO) and the U.S. Global Change Research Program (USGCRP)—that are primarily responsible for coordinating federal efforts with respect to observations of the earth's environment. The National Space Weather Program serves as the coordinating body for space weather. USGEO and USGCRP report to the Executive Office of the President through the National Science and Technology Council's Committee on Environment and Natural Resources, while the National Space Weather Program coordinates its activities through NOAA's Office of the Federal Coordinator for Meteorology.

The Executive Office of the President provides oversight for federal space-based environmental observation. Within the Executive Office of the President, the Office of Science and Technology Policy (OSTP), the Office of Management and Budget (OMB), and the Council on Environmental Quality carry out these governance responsibilities. In addition, the National Science and Technology Council and its Committee on Environment and Natural Resources provide the Executive Office of the President with executive-level coordination and advice.[2]

The NPOESS Program: Inception, Challenges, and Divergence

Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite (POES) series, which is managed by NOAA, and the Defense Meteorological Satellite Program (DMSP), which is managed by the Air Force.[3] Currently, there is one operational POES satellite and two operational DMSP satellites that are positioned so that

[2]The Council on Environmental Quality coordinates federal environmental efforts; the National Science and Technology Council coordinates science and technological policies and sets national goals for investments in those areas, and the Committee on Environment and Natural Resources provides advice on federal research and development efforts in the area of environment and natural resources.

[3]NOAA provides command and control for both the POES and DMSP satellites after they are in orbit.

they cross the equator in the early morning, midmorning, and early afternoon. In addition, the government is also relying on a European satellite, called the Meteorological Operational (MetOp) satellite.[4] Together, they ensure that, for any region of the earth, the data provided to users are generally no more than 6 hours old.

With the expectation that combining the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive required NOAA and DOD to converge the two satellite programs into a single satellite program—NPOESS—capable of satisfying both civilian and military requirements.[5] To manage this program, DOD, NOAA, and NASA formed a tri-agency Integrated Program Office, with NOAA responsible for overall program management for the converged system and for satellite operations; the Air Force responsible for acquisition; and NASA responsible for facilitating the development and incorporation of new technologies into the converged system.

Since the program's inception, NPOESS costs have grown by over $8 billion, and launch schedules have been delayed by over 5 years. In addition, as a result of a 2006 restructuring of the program, the agencies reduced the program's functionality by decreasing the number of originally planned satellites, orbits, and instruments. The restructuring also led agency executives to mitigate potential data gaps by deciding to use a planned demonstration satellite, called the NPOESS Preparatory Project (NPP) satellite, as an operational satellite providing climate and weather data. Even after this restructuring, however, the program continued to encounter technical issues, management challenges, schedule delays, and further cost increases. To address these issues, in recent years we have made a series of recommendations to, among other things, improve

[4]The European Organisation for the Exploitation of Meteorological Satellites' MetOp program is a series of three polar-orbiting satellites dedicated to operational meteorology. MetOp satellites are planned to be launched sequentially over 14 years. The first of these satellites was launched in 2006 and is currently operational.

[5]Presidential Decision Directive NSTC-2, May 5, 1994.

executive-level oversight and develop realistic time frames for revising cost and schedule baselines.[6]

In August 2009, the Executive Office of the President formed a task force, led by OSTP, to investigate the management and acquisition options that would improve the NPOESS program. As a result of this review, the Director of OSTP announced in February 2010 that NOAA and DOD will no longer jointly procure the NPOESS satellite system; instead, each agency would plan and acquire its own satellite system. Specifically, NOAA is to be responsible for the afternoon orbit and the observations planned for the first and third NPOESS satellites. DOD is to be responsible for the early-morning orbit and the observations planned for the second and fourth NPOESS satellites. The partnership with the European satellite agencies for the midmorning orbit is to continue as planned.

[6]GAO, *Polar-orbiting Environmental Satellites: With Costs Increasing and Data Continuity at Risk, Improvements Needed in Tri-agency Decision Making*, GAO-09-564 (Washington, D.C.: June 17, 2009); *Environmental Satellites: Polar-orbiting Satellite Acquisition Faces Delays; Decisions Needed on Whether and How to Ensure Climate Data Continuity*, GAO-08-518 (Washington, D.C.: May 16, 2008); and *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Technical Challenges and Risks Remain*, GAO-07-498 (Washington, D.C.: Apr. 27, 2007).

Agencies Have Started Planning Separate Acquisitions, but the Impact of This Approach Is Not Known and Key Risks and Challenges Remain

NOAA has developed preliminary plans for its new satellite acquisition program—called the Joint Polar Satellite System (JPSS)—to meet the requirements of the afternoon NPOESS orbit. Specifically, NOAA plans to acquire two satellites; the plans call for the first JPSS satellite to be available for launch in 2014, and the second JPSS satellite to be available for launch in 2018.[7] NOAA will also provide the ground systems for both the JPSS and DOD programs. NOAA is also planning technical changes to the satellites, including using a smaller spacecraft than the one planned for NPOESS and removing sensors that were planned for the NPOESS satellites in the afternoon orbit.[8] In addition, NOAA plans to transfer the management of acquisition from the NPOESS program office to NASA's Goddard Space Flight Center, so that it can be co-located at a space system acquisition center as advocated by an independent review team. NOAA has developed a team to lead the transition from NPOESS to JPSS, and plans to begin transitioning in July and complete the transition plan—including cost and schedule estimates—by the end of September.

DOD is at an earlier stage in its planning process, in part because it has more time before the first satellite in the morning orbit is needed. DOD officials are currently developing plans—including costs, schedules, and risks—for their new program, called the Defense Weather Satellite System. DOD expects to make final decisions on the spacecraft, sensors, procurement strategy, and staffing in August 2010, and begin the program immediately.[9]

Because neither agency has finalized plans for its acquisition, the full impact of OSTP's decision on the expected cost, schedule, and capabilities is unknown.

[7]NOAA officials noted that these dates could change as transition plans are developed.

[8]NOAA officials are currently revisiting plans for the Space Environment Monitor, which collects data to predict the effects of space weather on technological systems, and the Microwave Imager/Sounder, which collects microwave images and data needed for measurements such as rain rate and soil moisture. Although they plan to launch the Total and Spectral Solar Irradiance Suite, NOAA officials have not yet made a decision on which satellite will host the sensor.

[9]DOD had originally planned to make decisions on the spacecraft and sensors in June and October 2010, respectively, but revised the dates for these decisions in late June 2010.

- Cost: NOAA anticipates that the JPSS program will cost approximately $11.9 billion to complete through 2024.[10] Although this estimated cost is less than the current baseline and recent estimates for the NPOESS program, DOD will still need to fund and develop satellites to meet the requirements for the early morning orbit.[11] DOD's initial estimates are for its new program to cost almost $5 billion through fiscal year 2015.[12] Thus, the cost of the two acquisitions will likely exceed the baselined life-cycle cost of the NPOESS program.

- Schedule: Neither NOAA nor DOD has finalized plans that show the full impact of the restructuring on the schedule for satellite development. We have previously reported that restructuring a program like NPOESS could take significant time to accomplish, due in part to the time taken revising, renegotiating, or developing important acquisition documents, including contracts and interagency agreements.[13] With important decisions and negotiations still pending, it is likely that the expected launch date of the first JPSS satellite will be delayed.

- Capabilities: Neither agency has made final decisions on the full set of sensors—or which satellites will accommodate them—for their respective satellite programs. Until those decisions are made, it will not be possible to determine the capabilities that these satellites will provide and their associated costs.

Timely decisions on cost, schedule, and capabilities would allow both acquisitions to move forward and satellite data users to start planning for any data shortfalls they may experience. Until DOD and NOAA finalize

[10]This estimate includes approximately $2.9 billion in NOAA funds spent on NPOESS through fiscal year 2010, but does not include approximately $2.9 billion that DOD has spent through fiscal year 2010 on NPOESS. NOAA officials also reported that the JPSS cost estimate is at a higher confidence level than the previous NPOESS life-cycle cost estimates.

[11]Although the program baseline is currently $13.95 billion, we estimated in June 2009 that this cost could grow by about $1 billion. In addition, officials from the Executive Office of the President stated that they reviewed life-cycle cost estimates from DOD and the NPOESS program office of $15.1 billion and $16.45 billion, respectively.

[12]This estimate includes approximately $2.9 billion in DOD funds spent on NPOESS through fiscal year 2010. It is not a life-cycle cost estimate and could change as DOD completes its requirements review and analysis of alternatives for its new program. DOD has not yet developed a life-cycle cost estimate.

[13]GAO, *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold*, GAO-06-573T (Washington, D.C.: Mar. 30, 2006).

their plans, it is not clear whether the new acquisitions will meet the requirements of both civilian and military users.

Key Transition Risks and Continuing Development Challenges Threaten Satellite Data Continuity

Moving forward, the agencies face key risks in transitioning from NPOESS to their new programs, including loss of key staff and capabilities, delays in negotiating contract changes and establishing new program offices, failure to support the other agency's requirements, insufficient oversight of new program management, and potential cost growth from contract terminations and other program changes.

- *Loss of key staff and capabilities:* The NPOESS program office is composed of NOAA, NASA, Air Force, and contractor staff with knowledge and experience in the status, risks, and lessons learned from the NPOESS program. This knowledge will be critical to moving the program forward both during and after the transition period. However, within the past year, the program office has lost its Program Executive Officer, Deputy Program Executive Officer, and System Program Director—the top three individuals who oversee day-to-day operations. Thus, final critical decisions on work slow downs and priorities will be made by a new Program Executive Officer, who has only overseen the program for a few weeks. In addition, program office staff have already begun leaving—or looking for other employment—due to the uncertainties about the future of the program office. Unless NOAA and DOD are proactive in retaining these staff, the new program may waste valuable time if staff must relearn program details and may repeat mistakes made and lose lessons learned by prior program staff.

- *Delays in negotiating contract changes and establishing new programs:* According to NOAA officials, the plan for JPSS may require negotiations with contractors and between contractors and their subcontractors. In addition, both NOAA and DOD will need to establish and fully staff program offices to facilitate and manage the transition and new programs. Until decisions are made on how the program is to proceed with contract changes and terminations, the contractors and program office cannot implement the chosen solution, and some decisions, such as how to hold schedule slips to a minimum, could become much more difficult.

- *Failure to support the other agency's requirements*: As a joint program, NPOESS was expected to fulfill many military, civilian, and research requirements for environmental data. However, because the requirements of NOAA and DOD are different, the agencies may develop programs that meet their own needs but not the other's. If the agencies cannot find a way to build a partnership that facilitates both efficient and effective decision-

making on data continuity needs, the needs of both agencies may not be adequately incorporated into the new programs.

- *Insufficient oversight of new program management:* Under its new JPSS program, NOAA plans to transfer parts of the NPOESS program to NASA, but it has not yet defined how it will oversee NASA's efforts. We have reported that NASA has consistently underestimated time and cost and has not adequately managed risk factors such as contractor performance. Because of these issues, we listed NASA's acquisition management as a high-risk area in 1990, and it remains a high-risk area today.[14] NOAA officials reported that they are developing a management control plan with NASA and intend to perform an independent review of this plan when it is completed. They could not provide a time frame for its completion. Without strong NOAA oversight of NASA's management of program components, JPSS may continue to face the same cost, schedule, and contract management challenges as the NPOESS program.

- *Cost growth resulting from contract and program changes:* Because neither acquisition has fully developed plans for their respective programs, it is unclear whether contracts will need to be fully or partially terminated, and what the terminations and other program changes could ultimately cost. We have previously reported that if the government decides to terminate a contract for convenience, it must compensate the contractor—in the form of a termination settlement—for the work it has performed.[15] However, a settlement only addresses the government's obligation under a terminated contract, and there may be additional costs. For example, additional costs could result from awarding a new contract to replace a terminated contract. Until NOAA and DOD make decisions and plans for their programs, the full cost of contract and program changes will be unknown.

  NOAA, NASA, and DOD acknowledge that there are risks associated with the transition to new programs, but they have not yet established plans to mitigate these risks.

  While NOAA and DOD are developing plans for their new programs, the development of key NPOESS components is continuing. In recent months, the program completed the development of the critical imaging sensor,

[14]GAO, *High-Risk Series: An Update*, GAO-09-271 (Washington, D.C.: January 2009).

[15]GAO, *Defense Acquisitions: Termination Costs Are Generally Not a Compelling Reason to Continue Programs or Contracts That Otherwise Warrant Ending*, GAO-08-379 (Washington, D.C.: Mar. 14, 2008).

called the Visible/Infrared Imager/Radiometer Suite (VIIRS), and delivered it to NASA for integration onto the NPP satellite. Four of the five sensors intended for NPP are now on the spacecraft. In addition, the program continues to work on components of the first and second NPOESS satellites, which are to be transferred to NOAA and DOD to become part of their respective follow-on programs. However, the expected launch date of the NPP satellite has been delayed by 9 months (moving the launch date to September 2011 or later), due to technical issues in the development of the NPP sensor that has not yet been integrated. In addition, the development of the VIIRS sensor for the first NPOESS or JPSS satellite is experiencing significant cost overruns. Further, the program is slowing down and may need to stop work on key components because of potential contract liabilities and funding constraints, but it has not developed a prioritized list on what to stop first.

Until the transition risks are effectively mitigated, and unless selected components are able to continue scheduled development, the launches of NPP and the first NOAA and DOD satellites could be further delayed. Further launch delays are likely to jeopardize the availability and continuity of weather and climate data. For example, the POES satellite currently in the afternoon orbit is expected to reach the end of its lifespan at the end of 2012. If NPP is delayed, there could be a gap in polar satellite observations in the afternoon orbit. Similarly, a delay in the launch of the first JPSS satellite may lead to a gap in satellite data after NPP reaches the end of its lifespan.

Federal Efforts to Ensure the Long-term Provision of Environmental Data from Satellites Are Lacking

For over a decade, the climate community has clamored for an interagency strategy to coordinate agency priorities, budgets, and schedules for environmental satellites over the long term—and the governance structure to implement that strategy. Specifically, in 1999, the National Research Council reported on the need for a comprehensive long-term earth observation strategy and, in 2000, for an effective governance structure that would balance interagency issues and provide authority and accountability for implementing the strategy.[16] The National Research Council and others have repeated these concerns in multiple reports since

[16]National Research Council, Climate Research Committee, *Adequacy of Climate Observing Systems* (Washington, D.C.: 1999); National Research Council, Space Studies Board: Committee on Earth Studies, *Issues in the Integration of Research and Operational Satellite Systems for Climate Research: Part I. Science and Design* (Washington, D.C.: 2000).

then, including after the agencies responsible for NPOESS canceled key climate and space weather sensors from the program in 2006.[17] Similarly, in 1999, the Administrators of NOAA and NASA wrote letters to OSTP noting the need for an interagency strategy and the means to implement it.

While progress has been made in developing near-term interagency plans, this initiative is languishing without a firm completion date, and federal efforts to establish and implement a strategy for the long-term provision of satellite data are insufficient. Specifically, in 2005, the National Science and Technology Council's Committee on Environment and Natural Resources established USGEO to develop an earth observation strategy and coordinate its implementation. Since that time, USGEO assessed current and evolving requirements, evaluated them to determine investment priorities, and drafted the Strategic Assessment Report—a report delineating near-term opportunities and priorities for earth observation from both space and ground. According to agency officials, this report is the first in a planned series, and it was approved by OSTP and multiple federal agencies in May 2009. However, OSTP has not yet forwarded the draft to the Committee on Environment and Natural Resources and the President's National Science and Technology Council because it is reconsidering whether to revise or move forward with the plan. USGEO officials could not provide a schedule for completing this near-term interagency plan.

This draft report is an important first step in developing a national strategy for earth observations, but it is not sufficient to ensure the long-term provision of data vital to understanding the climate. The draft report integrates different agencies' requirements and proposes continuing or improving earth observations in 17 separate areas, using both satellite and land-based measuring systems. However, the report does not include costs, schedules, or plans for the long-term provision of satellite data. While the report does note the importance of continuing certain near-term

[17]For example, see: National Research Council, Committee on a Strategy to Mitigate the Impact of Sensor Descopes and Demanifests on the NPOESS and GOES-R Spacecraft, *Ensuring the Climate Record from the NPOESS and GOES-R Spacecraft: Elements of a Strategy to Recover Measurement Capabilities Lost in Program Restructuring*, (Washington, D.C.: 2008); National Research Council, Committee on Earth Science and Applications from Space: A Community Assessment and Strategy for the Future, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (Washington, D.C.: 2007); Center for Strategic and International Studies (Wigbels, Lyn et.al.), *Earth Observations and Global Change: Why? Where Are We? What Next?: A Report of CSIS Space Initiatives* (Washington, D.C.: July 2008).

plans for sensors, it does not make recommendations for what to do over the long term.

In addition, the federal government lacks a clear process for implementing an interagency strategy. Key offices within the Executive Office of the President with responsibilities for environmental observations, including OSTP and the Council for Environmental Quality, have not established processes or time frames for implementing an interagency strategy—including steps for working with OMB to ensure that agencies' annual budgets are aligned with the interagency strategy. As a result, even if an interagency strategy was finalized, it is not clear how OSTP and OMB would ensure that the responsibilities identified in the interagency strategy are consistent with agency plans and are funded within agency budgets.

Until an interagency strategy for earth observation is established, and a clear process for implementing it is in place, federal agencies will continue to procure their immediate priorities on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and the continuity of key measurements may be jeopardized. This will hinder our nation's ability to understand long-term climate changes.

Federal Agencies Lack a Strategy for the Long-term Provision of Space Weather Data

While key federal agencies have taken steps to plan for continued space weather observations in the near term, they lack a strategy for the long-term provision of space weather data. Similar to maintaining satellite-provided climate observations, maintaining space weather observations over the long term is important. The National Space Weather Program, the interagency coordinating body for the United States space weather community, has repeatedly recommended taking action to sustain the space weather observation infrastructure on a long-term basis.

Agencies participating in the National Space Weather Program have taken short-term actions that may help alleviate near-term gaps in space weather observations, but OSTP has not approved or released two reports that are expected to establish plans for obtaining space weather observations over the long term. Specifically, NOAA and DOD are seeking to replace key

experimental space-observing satellites.[18] Further, the National Space Weather Program recently developed two reports at the request of OSTP documenting specific recommendations for the future of space weather, one on what to do about a critical NASA space weather satellite, called the Advanced Composition Explorer, and the other on the replacement of the space weather capabilities removed from the NPOESS program. The program submitted the reports in October and November of 2009, respectively. However, OSTP officials do not have a schedule for approving or releasing the reports.

While the agencies' short-term actions and the pending reports hold promise, federal agencies do not currently have a comprehensive interagency strategy for the long-term provision of space weather data. Until OSTP releases the reports, it will not be clear whether they provide a clear strategy to ensure the long-term provision of space weather data—or whether the current efforts are simply ad hoc attempts to ensure short-term data continuity. Without a comprehensive long-term strategy for the provision of space weather data, agencies may make ad hoc decisions to ensure continuity in the near term and risk making inefficient decisions on key investments.

Implementation of Recommendations Could Help Ensure Near- and Long-Term Satellite Continuity

In the report being released today, we are making recommendations to ensure that the transition from NPOESS to its successor programs is efficiently and effectively managed.[19] Among other things, we are recommending that the Secretaries of Defense and Commerce direct their respective NPOESS follow-on programs to expedite decisions on the expected cost, schedule, and capabilities of their planned programs; direct their respective NPOESS follow-on programs to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up new program offices, loss of support for the other agency's requirements, and oversight of new program management; and direct the NPOESS program office to develop priorities for work

[18]NOAA has requested funding in fiscal year 2011 to refurbish NASA's Deep Space Climate Observatory spacecraft to replace the experimental Advanced Composition Explorer spacecraft and has requested funding to replace its Constellation Observing System for Meteorology, Ionosphere, and Climate. DOD has begun efforts to develop a replacement for its experimental Communication/Navigation Outage Forecasting System satellite, which is designed to sense space weather that affects how the Global Positioning System, high frequency radio, and other communications devices work in low latitude areas.

[19]GAO-10-558.

slowdown and stoppage to allow the activities that are most important to maintaining launch schedules to continue.

In written comments on the NPOESS report, both NOAA and DOD agreed with our recommendations and identified plans to implement them. In addition, NASA made comments on two of our findings. For example, NASA commented on our finding that NOAA would need to provide enhanced oversight of NASA's management of the JPSS program. NASA officials asserted that the proper basis for comparison should not be their leading-edge research missions, but, instead, should be their operational environmental satellite programs. However, the JPSS program does include leading-edge sensor technologies, and the complexity of these sensor technologies has been a key reason for the cost growth and schedule delays experienced to date on the NPOESS program. Thus, it will be important for both NOAA and NASA to ensure that the subcontractors are adequately managed so that technical, cost, and schedule issues are minimized or mitigated. The full text of the three agencies' comments and our evaluation of those comments are provided in the accompanying report.

In the report issued in April, we made recommendations to improve long-term planning for environmental satellites.[20] Specifically, we recommended that the Assistant to the President for Science and Technology, in collaboration with key Executive Office of the President entities (including the Office of Science and Technology Policy, the Office of Management and Budget, the Council on Environmental Quality, and the National Science and Technology Council) establish a deadline to complete and release three key reports on environmental observations. We also recommended that the Assistant to the President direct USGEO to establish an interagency strategy to address the long-term provision of environmental observations from satellites that includes costs and schedules for the satellites, as well as a plan for the relevant agencies' future budgets, and establish an ongoing process, with timelines, for obtaining approval of the interagency strategy and aligning it with agency plans and annual budgets.

When asked to comment on our report, the Executive Office of the President did not agree or disagree with our recommendations; however, officials noted that OSTP is currently revising USGEO's Strategic

[20]GAO-10-456.

Assessment Report to update information on launch schedules and on the availability of certain measurements that have changed since completion of the report a year ago. In crafting this strategy, it will be important for OSTP to address long-term interagency needs and to work with OMB to ensure that the long-term plans are aligned with individual agencies' plans and budgets. If the plan does not include these elements, individual agencies will continue to address only their most pressing priorities, other agencies' needs may be ignored, and the government may lose the ability to effectively and efficiently address its earth observation needs.

In summary, at the end of this fiscal year, the federal government will have spent 16 years and almost $6 billion to combine two legacy satellite programs into one, yet will not have launched a single satellite. Faced with expected cost growth exceeding $8 billion, schedule delays of over 5 years, and continuing tri-agency management challenges, a task force led by the President's Office of Science and Technology Policy decided to disband NPOESS so that NOAA and DOD could pursue separate satellite acquisitions. While the two agencies are scrambling to develop plans for their respective programs, it is not yet clear what the programs will deliver, when, and at what cost, but it is very likely that they will cost more than the existing NPOESS baseline and recent program office estimates. Timely decisions on cost, schedule, and capabilities are needed to allow both acquisitions to move forward. In addition, the agencies face a number of transition risks, but neither agency has developed plans to mitigate these risks. Meanwhile, the NPOESS program is continuing to develop components of the NPP satellite and components of the first two satellites. However, program officials reported that they have slowed all development work, and may need to stop work on these deliverables. Slowing or stopping work could further delay the satellites' launches, but the program has not developed a prioritized list of what to stop first to mitigate impacts on satellite launches. Until it does so, there may be an increased risk of gaps in satellite data.

Although initial steps have been taken to ensure the short-term continuity of key climate and space weather measurements from satellites, the federal government has not taken the necessary steps to ensure the long-term sustainment of these critical measurements. For example, NOAA recently removed sensors from JPSS that were originally planned for the NPOESS satellites in the afternoon orbit, but it is unclear how this will affect other agencies and programs. Until an interagency strategy for earth observation is established, and a clear process for implementing it is in place, federal agencies will continue to procure their immediate priorities

on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and the continuity of key measurements may be lost. This will hinder our nation's ability to understand long-term climate changes and risk our ability to measure, predict, and mitigate the effects of space weather.

GAO Contact and Staff Acknowledgments

If you have any questions on matters discussed in this testimony, please contact David A. Powner at (202) 512-9286 or at pownerd@gao.gov. Other key contributors include Colleen Phillips, Assistant Director; Kate Agatone; Franklin Jackson; Kathleen S. Lovett; Lee McCracken; and John Ockay.

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